

CLAIMS

We claim:

1. A luminaire comprising:
 - (A) a light transmissive optical element spaced from and disposed about an axis;
 - (B) a plurality of light sources disposed radially outwardly of the optical element relative to the axis, for producing a corresponding plurality of light beams, wherein each light source directs a corresponding one of the plurality of light beams toward the optical element, wherein the optical element is optically shaped to collect and pass in the direction of the axis the plural light beams received from the plurality of light sources,
 - (C) a light source support structure; and
 - (D) a light reflective surface spaced from the optical element and disposed along the axis, wherein the light reflective surface is optically shaped to redirect along the axis and combine the plurality of light beams passed by the optical element to produce a collimated beam of light from the re-directed plural light beams.
2. The luminaire of Claim 1, wherein the optical element is generally toroidal in shape and is formed by rotating a closed curved section about the axis.
3. The luminaire of Claim 1, wherein the light reflective surface is generally conical in shape and is formed by rotating a generally triangular section on the axis.

1 4. The luminaire of Claim 1, wherein each one of the plurality of light sources
2 is a light emitting diode.

1 5. The luminaire of Claim 1, wherein the plurality of light sources are equally
2 peripherally spaced radially outwardly of the optical element relative to the axis.

1 6. A luminaire comprising:

2 (A) a light transmissive optical element spaced from and disposed about an axis,
3 wherein the optical element is generally quasi-toroidal in shape;

4 (B) a plurality of light sources disposed radially outwardly of the optical element
5 relative to the axis, for producing a corresponding plurality of light beams, wherein each
6 light source directs a corresponding one of the plurality of light beams toward the optical
7 element, wherein the optical element is optically shaped to collect and transform the
8 plurality of light beams received from the plurality of light sources and to pass them in the
9 direction of the axis;

10 (C) a light source support structure; and

11 (D) a light reflective surface spaced from the optical element and disposed along
12 the axis, wherein the light reflective surface is generally conical in shape and is formed by
13 rotating on the axis a generally triangular section having a curved hypotenuse, and wherein
14 the light reflective surface is optically shaped to redirect along the axis and combine the

15 plurality of light beams passed by the optical element to produce a collimated beam of light
16 from the re-directed plural light beams.

1 7. The luminaire of Claim 6, wherein the plurality of light sources are equally
2 peripherally spaced radially outwardly of the optical element relative to the axis.

1 8. The luminaire of Claim 7, wherein each one of the plurality of light sources
2 is a light emitting diode.

1 9. The luminaire of Claim 7, wherein each one of the plurality of light sources
2 is a combination of red, green and blue light emitting diodes with controlled intensity.

1 10. A luminaire comprising:

2 (A) a light transmissive optical element spaced from and disposed about an axis,
3 wherein the optical element is substantially quasi-toroidal in shape and is formed by
4 rotating a closed curved section about the axis;

5 (B) a plurality of light sources disposed radially outwardly of the optical element
6 relative to the axis, for producing a corresponding plurality of light beams, wherein each
7 light source directs a corresponding one of the plurality of light beams toward the optical
8 element, wherein the optical element is optically shaped to collect and transform the
9 plurality of light beams received from the plurality of light sources and pass them in the
10 direction of the axis, wherein the plurality of light sources are equally peripherally spaced

11 radially outwardly of the optical element relative to the axis, and wherein each one of the
12 plurality of light sources is a light emitting diode;

13 (C) a light source support structure further comprising an effective amount of a
14 heat-transfer surface, disposed in a heat-transfer relationship with the plurality of light
15 sources, to provide for removal of heat that is generated by the plurality of light sources,
16 and

17 (D) a light reflective surface spaced from the optical element and disposed along
18 the axis, wherein the light reflective surface is generally conical in shape and is formed by
19 rotating about the axis a generally triangular section having a curved hypotenuse, and
20 wherein the light reflective surface is optically shaped to redirect along the axis and
21 combine the plurality of light beams passed by the optical element to produce a single
22 collimated beam of light from the re-directed plurality of light beams.

1 11. The luminaire of Claim 10, wherein the quasi-toroidal optical element
2 comprises an assembly of concentric quasi-toroidal components each having different
3 indices of refraction to redirect the plurality of light beams perpendicular to said axis.

1 12. The luminaire of Claim 10, wherein the light source support structure
2 further comprises a temperature-control device disposed within a support structure cavity in
3 association with a heat-transfer surface so that the light emitting diodes operate across a
4 wide temperature range and within one of the following specified performance parameters:
5 luminous output, color, and spatial luminous intensity distribution.

- 1 13. The luminaire of Claim 10, wherein the light transmissive optical element
- 2 and the light reflective surface are mutually designed and calculated to provide equal
- 3 luminous intensity distribution across the single collimated beam of light.